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FPGA IMPLEMENTATION FOR EFFICIENT LIFT CONTROL SYSTEM

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ABSTRACT

The lift control framework is one of the most crucial elements of the hardware control modules used in automotive applications. Most of the time, elevators are designed with a certain building in mind. With predetermined information inputs and outputs, the FPGA may run across any number of floors while controlling utilisation. By simply altering a control variable in the HDL code, this controller can be utilised for a lift with theneeded number of floors. To achieve a good response time without including any additional logic circuits, a simple plan is adopted in the design. A revolutionary FPGA-based elevator controller addresses the drawbacks of conventional single-chip microcomputer-based elevators.

1. INTRODUCTION

Global demand for Very Large Scale Integration has increased as a result of the semiconductor industry's tremendous growth over the past 20 years. The fundamental ideas of digital logic theory and methodologies may be easily understood using VLSI- based designs. the fundamental ideas behind complex, fast digital circuitry. Every day, technology continues to advance. It follows that the designs must be made simpler in order to gain the benefits. The goal of an integrated circuit is to create an eight-floor elevator controller that can work as a part of an elevator controller. The elevator determines where to take passengers by comparing the current floor with the desired floor and providing instructions. subject to the conditions that the weight be less than 4500 lbs. and the door close in three minutes. If the weight goes over that limit, the elevator will alert you right away. When the door has been open for more than three minutes, the Door Alert signal, which is typically quiet, becomes louder. If the elevator has passed the currentfloor is determined by a sensor on each floor.

The sensor's signal contains an encoding for the floor that was previously traversed. This paper offers a novel approach for enhancing the reliability of a reconfigurable FPGA-based elevator controller with predetermined inputs and outputs. Any elevator, regardless of how many floors it has, can use this controller. Historically, steam and water hydraulic pistons or human labour were used to power the driving systems for elevators. In a "traction" elevator, vehicles are raised by rolling steel ropes over a sheave, or pulley, having a deep groove. The car's weight is balanced by a counterweight. There are times when two elevators are built to move simultaneously in opposite directions and balance one another. This particular kind of elevator gets its name from the traction produced by the friction between the ropes and the pulley.

By exerting pressure on an above- or below-ground piston using the principles of hydraulics (as in hydraulic power), hydraulic elevators raise and lower the car. Recent innovations include gearless machines mounted on tracks without needing a machine room, permanent magnet motors, microprocessor controllers, and more. The technology used in new installations is impacted by a number of factors. Although it is impractical to construct cylinders longer than a certain length for very high lift hoist systems, hydraulic elevators are less expensive. For structures taller than seven stories, traction elevators are required. Hydraulic elevators often move more slowly than traction elevators. Elevators could be mass-customized. Cost savings can be achieved by mass producing the components, however each construction has unique requirements, such as different floor counts, well diameters,and so on.

2. ELEVATOR CONTROLLER

Elevators were originally created as a convenience, but they have since developed into a necessary part of modern urban life. "A machine that takes people or products up and down to different levels in a building or mine" is the definition of an elevator. One master controller can control and coordinate the activities of several separate elevator units that make up an elevator system. Each elevator unit is a straightforward electromechanical machine. The apparatus uses the floor level as an input and produces control signals to manage lift activity.

3. LITERATURE SURVEY

Survey I-

Dumbwaiters and workplace elevators both operate in essentially the same ways. One such application is studied and simulated in this piece of work using a five-story elevator controller as an example.

Because it can be reused, can be reprogrammed, and allows for quicker and less expensive prototyping, a Field Programmable Gate Array (FPGA) was selected for this study. To move the elevator from its present state to the intended next state, the elevator control system uses a Finite State Machine (FSM), which gathers floor inputs from inside the elevator as wellas up and down calls from outside.

Survey II-

To sustain 23 buildings at the dawn of an era of highly varied new technology. The elevator in a high-rise structure enables residents to move vertically between floors. This study includes a four-phase lift controller that uses finite state machines and Verilog HDL code (FSM)

Survey III-

An essential component of the hardware control modules utilised in automotive applications is the lift control framework. Often, when designing a lift, a particular building is taken into account. Use is managed by the FPGA, which has predetermined information inputsand outputs and may function across any number of levels.Just changing a control variable in the HDL code will enable this controller to work with a lift that has thenecessary number of floors.

4. PROPOSED WORK

Throughout the coding phase, we used a variety of techniques to keep the programme running.To avoid using the same variable name for both the input current floor and the output current floor, we first gave themdifferent names. Additionally, we add two new input pins to the code called Over time and Over weight. Thesesignals will be delivered to the controller by the mechanical device. When the controller receives a signal from a weightalert or door alert, the elevator won't move while it's on theOut Current Floor.

Then, everything will come together as one. Lastly, create the Out Current Floor, Direction, Complete,Door Alert, and Weight Alert regs and assign equal valuesto the output. The variables will so serve as an output and register. The variables Complete, Door Alert, and Weight Alert are initialised to zero when the Reset switch is not depressed. The variable In Current Floor is similarly only once set to equal Out Current Floor when the Request Flooris enabled.

Even when the Out Current Floor equals the Request Floor, it still updates and compares with it. Mention three if statements pertaining to elevators as a final point.

When an elevator is working properly, it compares the Request Floor and Out Current Floor to determine which way to move; however, it activates the Door Alert ifa door is left open for longer than three minutes, and it activates the Weight Alert if it is transporting obese passengers.

5. BLOCK DIAGRAM

The inputs and outputs of the elevator controller are shown in the block diagram below.

Fig.3.1. Block diagram of lift controllerINPUTS

Define Request Floor as an input variable of type 8-bit.The numbers from 00000001 to 10000000 correspond to the first through eighth floors. (The second storey has the designation 00000010, while the third floor has the number 00000100. For In Current _Floor, add a definition for an 8-bit input variable. Instead, the Out Current _Floor that has reached the target floor may be used to specify the top floorand every floor below it. It will be helpful to define clk as an input variable. clocks with low frequency are made. To create a reset. Make Over Time an input variable. The number "1" in the tz Verilog code denotes that the waitingduration exceeds three minutes. The signal from the timer will be Input Over Time (machinery part). Over Weight should be used as the definition of the input variable. In Verilog code, the number "1" denotes an elevator overload.A signal from the weight detector will be input over weight (machinery part).

6. OUTPUTS

Provide the name Direction to the output variable. The numbers "1" and "0" in Verilog code represent upward and downward motion, respectively. Provide the value Complete to the output variable. The elevator that enters the designated floor is represented by the number "1" in theVerilog code. In cases when the Over Time or Weight Warning is enabled, it can also be used in place of stopping(remain stationary at the Out Current Floor). It is necessaryto set a Door Alert output variable. Output Door Alert will also be functional. Choose Weight Alert as the desired output parameter. The number "1" represents a busy elevator. When Over Weight is active, Input Weight Alertalso becomes active. Define the output variable Out Current _Floor as an 8-bit value. This specific variable willbe utilised.

7. THREE CASES OF ELEVATOR

Case I- An example of how the elevator usually operates.The elevator will move up if the Request Floor is higher than the R Out Current Floor. If the Request Floor is belowthe R Out Current Floor, the elevator will depressurize. If the Request Floor equals the R Out Current Floor (it reaches the Request Floor), the R Complete is on, and the elevator stops travelling. The "1" and ">>1" represent shiftregisters. By one, the desired orientation is introduced intothe data. In this case, "1" will transform "00000001" into "00000010."

Case II- About three minutes had passed since I last shutthe door. Both the R Door Alert and R Complete are set to ON when the Reset is disabled but Over Time is enabled. Off is an option for both the R Weight Alert and R Direction. Information is maintained there by the R Out Current Floor. The elevator will halt (or pause) and the door alarm will cease to operate once the countdown has ended. Case III- Almost 4500 pounds of weight may be supported by the elevator. The R Weight Alert and R Complete are set to be ON if Over Weight is enabled but Reset is disabled. R Door Alert and R Direction are ineffective. To R Out Current Floor, the R Out Current Floor keeps its data. As a result, if an elevator is too full, the weight alert ring will ring and it will stop (or pause) moving.

8. IMPLEMENTATION USING FPGA

The term "FPGA" refers to field-programmable gate array. An FPGA is essentially a collection of interconnected digital subcircuits that can be extremely flexible while carrying out a number of related activities. An FPGA doesnot consist just of a Boolean gate array. This would be a farinferior method of enabling adjustable logic because it would not benefit from the fact that common operations can be carried out much more successfully as fixed modules. The same principle underlies discrete digital integrated circuits. Hence, an FPGA is considerably more than just a gate array. It is composed of numerous well constructed and interconnected digital subcircuits that cooperate to carry out essential tasks while also enabling agreat deal of flexibility. Customizable logic blocks (CLBs),which are digital sub-circuits, are used to build programmable logic by the FPGA. Previously known as Altera Quartus II, Intel Quartus II is aprogramme used to design programmable logic devices. Quartus Prime enables developers to compile, run timing analyses, view RTL diagrams, simulate a design's response to various stimuli, and analyse and synthesise HDL designs. Quartus Prime also enables developers and programmersto collaborate on setting up the target device. Quartus Prime offers a VHDL and Verilog implementation for hardware description, visual logic circuit editing, and vector waveform simulation.

9. RESULTS

Simulation Result I-**Request floor = 00000001;In_Current_floor = 10000000**

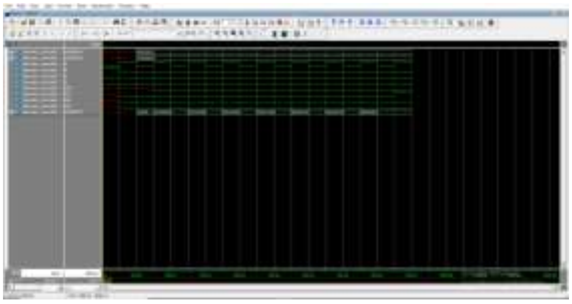

Fig. 1. Simulation Result 1

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Request floor = 00001000; In Current floor = 10000000,

according to Simulation Outcome II.

Fig. 2. Simulation Result 2 QUARTUS TOOL SIMULATION RESULTS

RTL VIEW

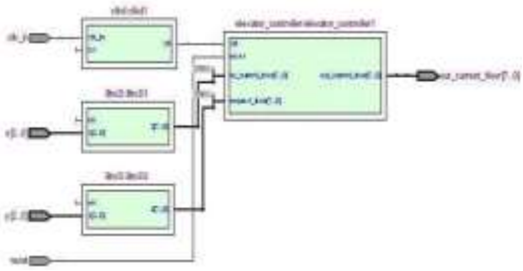

Fig .3.RTL view

CLOCK IN

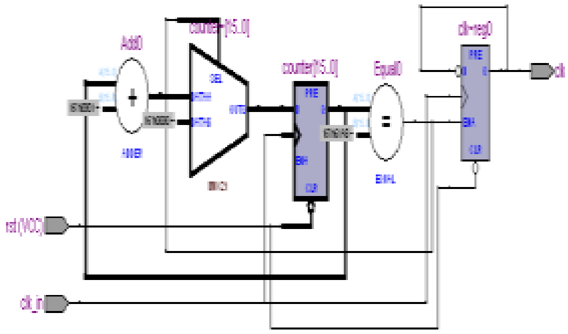

Fig. 4. clock in

BINARY TO DECIMAL DECODER

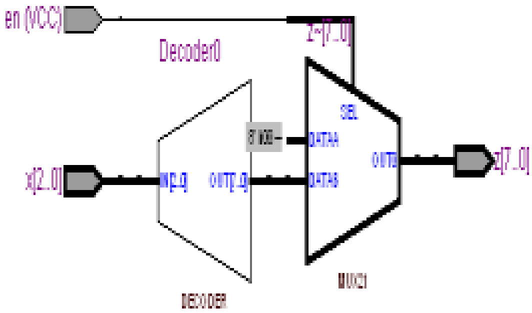

Fig. 5. Binary to decimal converterCONTROLLER BLOCK

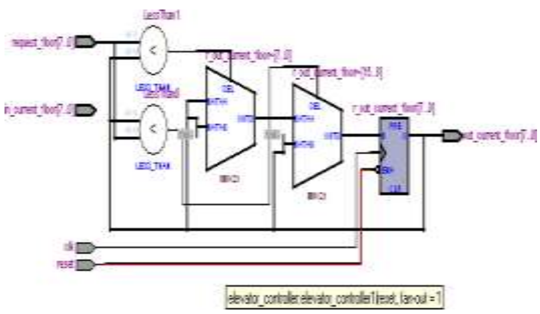

Fig. 6. Controller Block Synthesized Report

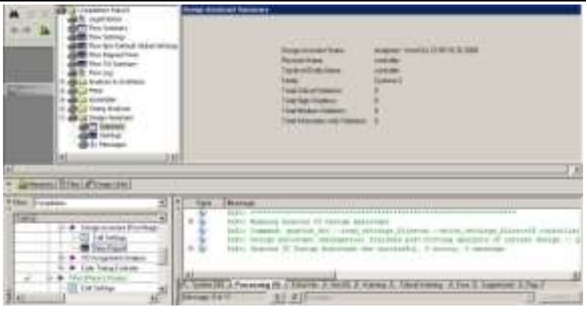

Fig.7. Synthesized report

Implementing Verilog code in EP2C35F6723

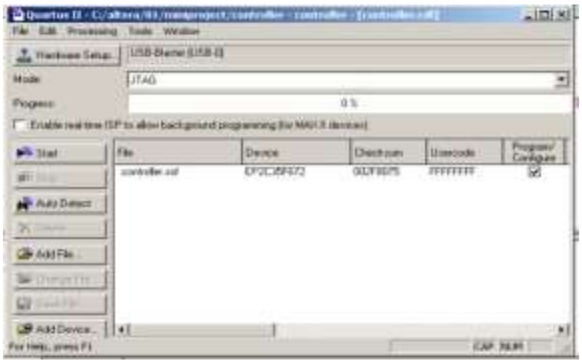

Fig. 8. Implementation

10. CONCLUSION

An efficient lift control system is designed and implemented in an FPGA using VHDL. The elevator controller inputs the required floor, and then outputs what the user has asked for. The modelsim tool simulates this liftmovement from the current floor to the desired floor, and the results are generated as a waveform. The Verilog code is then implemented using the FPGA Cyclone 2 (ep2c35f67236). In Register Transfer Level view, the implemented verilog code is reviewed, reported on, and shown.

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